Kinetics of decomposition of un-conventional farm-based residues and their composting and quality monitoring

Abstract

Castor and sunflower, drought-tolerant crops, are cultivated in the semi-arid tropics of the world. The nutrient-rich residues of these crops are mostly burnt because of their high C/N (C/N)-ratios. These high C/N-ratio residues can be composted and recycled successfully, if they are supplemented with other low C/N-ratio farm-based organics and some chemical additives. To study the rate kinetics and half-life of decomposition of castor (C/N ratio: 75:90) and sunflower (C/N ratio 57:47) residue mixtures and the manure value of the compost thus prepared, two on-farm experiments were conducted at Hayathnagar Research Farm (17° 18' N latitude, 78° 36' E longitude, and an elevation of 515 m above sea level) of Central Research Institute for Dryland Agriculture, Hyderabad, India. The decay rate constants obtained on the basis of the exponential functions using the data on weight loss, C concentration, and C/N ratios indicated that among the four combinations of treatments, castor stalks+gliricidia loppings+cattle dung had the fastest rate of decomposition with an average rate constant value of 0.0043 day^{-1}. To achieve 50% decomposition (half-life), the time periods computed for castor stalks+gliricidia loppings+cattle dung and sunflower stalks+gliricidia loppings+cattle were 197 and 278 days, respectively. On an average basis, sunflower-based manure contained a significantly higher amount of total N (14.6 gm kg^{-1}) than castor-based manures (12.2 gm kg^{-1}). The corresponding total hydrolyzable N values were 8.2 and 8.15 gm kg^{-1}, respectively. Amino acid N was found to be the predominant constituent of the total acid hydrolyzable N in the manure. Use of earthworms in composting enriched the manure in terms of mineral [nitrate (NO_3)+ammonium (NH_4)-N] and hexosamine-N fractions. The full article deals with the decomposition patterns (periodical changes in weight loss, C concentration and C/N ratios), decay-prediction functions, composting, and manure quality of the castor- and sunflower-based residue mixtures.

Keywords: Residue decomposition, composting of unconventional farm-based residues, castor and sunflower stalks, N fractions, total N, mineral N, total hydrolyzable N